REMARKS

Claims 1, 4, 7, 9, 14-17, 20-21, 23-26, 28, 35-37, 41 and 43-47, 49-52, 54, 58-61, 64-67 and 69 are pending for further examination. Claims 1 and 64-65 are currently amended to incorporate the subject matter of claim 18, now canceled. Claims 35 is currently amended to incorporate the subject matter of claim 40, now canceled. Claim 67 is currently amended to incorporate the subject matter of claim 37. Claim 50 is currently amended to correct an informality. Claims 2-3, 6, 48, 53, 55-57, 62-63, 68 and 70 are withdrawn as the result of a previous restriction requirement.

Claim Rejections Under 35 U.S.C. § 112, ¶ 1

Claims 4, 18, 21, 40, 51, 66 and 69 were rejected under 35 U.S.C. § 112, ¶ 1 as allegedly failing to comply with the enablement requirement. However, the stated reason for this rejection is that the specification fails to provide *support* for the limitations recited in the foregoing claims. Thus, it appears that what was intended was a written description rejection. As discussed more fully below, Applicants respectfully submit that each of these claims are adequately supported in the originally filed specification, which provides sufficient detail so as to enable one of ordinary skill in this art to make and use the invention.

Pending claim 4 recites that a reflector is a "photonic bandgap crystal" and pending claim 69 recites that the photonic bandgap crystal is a "volume diffractive grating." Support for those features can be found, for example, on page 14, lines 18-23 of the originally filed specification, which discloses that a "photonic bandgap crystal reflector 404 also can include variations of the index of refraction that occur along different axes within the volume of the material. Such crystals can be created...self-assembly of a crystal or crystalline structure having a pattern of variations of the index of refraction within its volume." (Emphasis added). In addition, page 2, lines 25-27 of the originally file specification disclose that the reflector can be "a volume diffractive grating, an interference filter, a photonic bandgap crystal, a volume Bragg grating, or a holographic grating." (Emphasis added). Such crystals and gratings are commercially available in the field.

As explained above, claim 1 is currently amended to include the subject matter of now canceled claim 18, which previously recited that the reflector has a reflectivity spectral width "less than 0.2 nm." Claim 66 recites a light source that includes, among other things, a reflector aligned with an output beam of a diode laser such that an emission spectrum of the laser is "stabilized to within about 0.2 nm." Claim 51 recites that the reflector has a reflectivity spectral width that is "less than 0.01 nm." Support for those features can be found, for example, on page 3, lines 9-10, of the originally filed specification, which discloses that a reflector can have a reflectivity spectral width "that is <u>less than 0.2 nm or less than 0.01 nm</u>." (Emphasis added). One of ordinary skill would be able to obtain a reflector with such low reflectivity spectral width.

Claim 21 recites, among other things, that the reflector is configured to provide selective feedback to a diode laser such that the "sidemode suppression ratio in the light source is greater than -30 dB." Support for that feature can be found, for example, on page 3, lines 11-15 of the originally filed specification, which discloses that a reflector can be adapted and arranged relative to a diode laser to provide selective feedback "such that the <u>sidemode suppression ratio in the light source is greater than -30dB</u>," (emphasis added), and on page 18, lines 1-3, which discloses that it is possible to achieve an external cavity laser with "<u>more than -30 dB side mode suppression</u>." (Emphasis added). Applicants' overall disclosure is sufficient to enable such a sidemode suppression ratio.

Claim 35 is currently amended to include the subject matter of now canceled claim 40, which previously recited that output beams of a first laser and second laser have "different polarizations." Support for that feature can be found, for example, in the originally filed specification on page 21, lines 31-33, which discloses an example of spectrally combining narrow bandwidth light sources 702a, 702b, 702c, 702d, and 702e "having different optical properties (e.g., wavelength or <u>polarization</u>)…" (Emphasis added). Taught by Applicants' disclosure and general knowledge in the field, the person of ordinary skill would have been able to make and use such a configuration.

Claim 66 recites a light source that includes, among other things, a reflector aligned with an output beam of a diode laser such that an emission spectrum of the laser is "stabilized to

within about 0.2 nm over a temperature range of about 35 °C and over a drive current that changes by a factor of 2.5." Support for those features can be found, for example, in the originally filed specification on page 16, line 29 – page 17, line 2, which discloses that, in comparison to a light source, operating over a temperature range from about 20 °C to about 55 °C, that does not include a reflector, the output wavelength of a laser with the claimed reflector shifts by "less than about 0.2 nm over this temperature range" and that the presence of the reflector can reduce the dependence of the peak wavelength on the drive current "by a factor of about 2.5." (Emphasis added). Such features would also be enabled by Applicants' disclosure, in combination with generally known principles.

In view of the foregoing examples, Applicants submit that the present disclosure clearly provides support for the claimed features. In addition, Applicants note that the Office has failed to meet its burden for establishing lack of enablement under 35 U.S.C. § 112, ¶ 1. In particular, when setting forth a rejection based on lack of enablement, the Office is required to "establish a reasonable basis to question the enablement provided for the claimed invention." (*See* Manual of Patent Examining Procedure § 2164.04). The Office has failed to do so here. Instead, the Office simply asserts, without explanation or evidence, that the claims fail to comply with the enablement requirement. Accordingly, Applicants respectfully request withdrawal of the claim rejections under 35 U.S.C. § 112, ¶ 1.

Claim Rejections Under 35 U.S.C. § 112, ¶ 2

Claims 50 and 54 were rejected under 35 U.S.C. § 112, ¶ 2 as allegedly failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

In particular, the Office alleges that the subject matter recited in present claim 50 (*i.e.*, "the reflector is in contact with a rear facet of the diode laser") is conflicting with the subject matter of claim 1, from which claim 50 depends, because "the output of the diode laser (or laser diode) is emitted in front of the laser, not from the rear" (*see* Office action at p. 3). Applicants

respectfully disagree and note that claim 1 does not require that the output of the laser diode be emitted in front of the laser.

Instead, claim 1 recites that the reflector is "in optical communication with the semiconductor diode laser to receive an output beam of the diode laser, such that a portion of the light in the output beam is reflected back into the laser." There is no requirement in claim 1 that the output beam is emitted from a "front" of the diode laser or that the reflector receives an output beam from a "front" of the diode laser. Furthermore, Applicants point the Office to FIG. 10 and page 17, lines 14-16 and FIG. 10 of the present application, which discloses that a front surface of a reflector "can be attached or placed close to the end surface 18a of the laser 10, such that the reflector acts as the rear mirror of the laser 10."

The Office further states that "it is not clear how the reflector stabilizes one or more of the spatial beam quality and the spectral line width of the diode laser" (*see* Office action at p. 3). Applicants note that the examples disclosed on pages 11-13 of the present specification establish how a reflector stabilizes one or more of the spatial beam quality and spectral line width of a diode laser.

The Office also alleges that the subject matter of claim 54 (*i.e.*, "the laser active medium is an active medium of a disk laser") conflicts with claim 1 because claim 1 recites a semiconductor diode laser, "which cannot be a disk laser" (*see* Office action at p. 4). Applicants note that claim 54 depends from claim 52 which recites that the laser active medium absorbs at least a portion of "the <u>output beam</u> and is pumped by the <u>output beam</u>" of the laser diode. Accordingly, the laser active medium recited in claim 54 is not of the semiconductor diode laser recited in pending claim 1. Instead, the laser active medium is a laser medium separate from the semiconductor laser diode recited in pending claim 1. Applicants note the examples disclosed on pages 19-21 of the present specification in which the combination of a diode laser and reflector can be used to provide pump light to a solid state laser.

The Office requires correction of the term "contract" in claim 50. Applicants have amended claim 50 to correct this informality.

In view of the foregoing comments, Applicants respectfully request withdrawal of the claim rejections under 35 U.S.C. § 112, ¶ 1.

Claim Rejections Under 35 U.S.C. §§ 102/103

Claims 1, 7, 9, 14-17, 20, 23-26, 28, 35, 37, 40-41, 43-47, 49-50, 58-61, 64-65 and 67 are rejected under 35 U.S.C. § 102(e) as anticipated by the Volodin et al. reference (U.S. Patent App. Publication No. 2005/0018743). Claims 1 and 4 were also rejected under 35 U.S.C. § 102(e) by the Deng et al. patent (U.S. Patent No. 6,704,343). Claims 52 and 54 were rejected under 35 U.S.C. § 103(a) as obvious over the Volodin et al. reference. In view of the foregoing amendments and the following remarks, Applicants respectfully request reconsideration and withdrawal of the claim rejections.

Claims 1, 4, 7, 9, 14-17, 20, 23-26, 28, 44-47, 49-50, 52, 54, 58-60 and 64-65

Independent claim 1 recites, among other things, a light source that includes a multi-spatial mode semiconductor diode laser and a reflector having a three-dimensional pattern of refractive index variations within the reflector. The reflector has a reflectivity spectral width that is "less than 0.2 nm" and is in optical communication with the diode laser to receive an output beam of the diode laser, such that a portion of the light in the output beam is reflected back into the laser by the reflector to stabilize the spectral line width of the laser.

In general, the center wavelength and spectral width of a high power wide stripe/edge-emitting laser diode are relatively unstable due to the heat generated by the laser diode during operation under various drive currents. Applicants have determined, however, that by using a reflector having a reflectivity spectral width which is "less than 0.2 nm", in conjunction with a high-power wide stripe/edge emitting laser, it is possible to stabilize both the center wavelength and spectral width of the resultant emission over a broad range of input drive currents and/or thermal conditions. Accordingly, the reflectivity spectrum of the reflector can have a stable center wavelength and spectral width compared to the emission spectrum of the diode laser from which the laser output beam is generated. Thus, in some implementations, the center wavelength

and spectral width of the overall laser-reflector system can be relatively insensitive to the temperature of the system.

In contrast, none of the cited references disclose the subject matter of pending claim 1. The Volodin et al. reference discloses a volume Bragg grating (VBG) element 106 that receives laser radiation emitted from a laser 100 and reflects the radiation back into the laser 100 (*see* FIGS. 1A-1C; ¶ [0078]). There is no disclosure in the Volodin et al. reference, however, of a reflector having a three-dimensional pattern of refractive index variations, in which the reflector has a reflectivity spectral width that is "less than 0.2 nm," as recited in pending claim 1. Nor does the Volodin et al. reference support any reason to have a reflector with a reflectivity spectral width that is "less than 0.2 nm." Although the Volodin et al. reference broadly discloses narrowing spectral width, a person of ordinary skill in the art would not have had any reason to form a reflector having the particular range of reflectivity spectral width, as recited in pending claim 1. Applicants have realized, moreover, that a reflector with a reflectivity spectral width of "less than 0.2 nm" can be used to stabilize the output of a high power wide stripe/edge-emitting laser, thus producing a more useful product for some applications.

The Deng et al. patent discloses a vertical cavity surface emitting laser (VCSEL) 400 that includes a substrate 410, an active region 406, distributed Bragg reflector (DBR) layers 404, 408, and a photonic crystal 402 (*see* FIG. 4). The high reflectivity of the photonic crystal reduces the number of DBR layers that need to be formed in the VCSEL (*see* col. 4, lines 59-64). There is no disclosure in the Deng et al. patent, however, that the photonic crystal 402 (which the Office alleges corresponds to the claimed "reflector") has a reflectivity spectral width that is "less than 0.2 nm," as recited by pending claim 1. Nor does the Deng et al. patent support any reason to have a reflector with a reflectivity spectral width that is "less than 0.2 nm."

Accordingly, neither the Volodin et al. reference nor the Deng et al. patent discloses the subject matter of pending claim 1. Nor would a person of ordinary skill in the art have had any reason to modify the claimed references to obtain the claimed subject matter, based solely on the known prior art. For at least the foregoing reasons, Applicants submit that independent claim 1 is

allowable over the Volodin et al. reference and the Deng et al. patent and ask, therefore, that the prior art rejections of claim 1 be withdrawn.

Claims 4, 7, 9, 14-17, 20, 23-26, 28, 44-47, 49-50, 52, 54 and 58-60 depend from claim 1 and should be allowed for at least the same reasons as claim 1.

Claims 64 and 65 each recite, among other things, a light source that includes a multi-spatial mode semiconductor diode laser and a reflector aligned with an output beam of the diode laser, in which the reflector has a spectral reflectivity width that is "less than 0.2 nm." As explained above in regard to independent claim 1, the Volodin et al. reference neither discloses nor renders obvious a reflector that has spectral reflectivity width that is "less than 0.2 nm." Accordingly, Applicants submit that claims 64 and 65 are allowable over the Volodin et al. reference and ask, therefore, that the prior art rejections of claims 64 and 65 be withdrawn.

Claims 13, 21, 51, 66 and 69

Claims 21, 51 and 66 were not rejected in view of any prior art, and are presumed to be allowable upon withdrawal of the rejections under 112. Claim 13 was not rejected, and is presumed to be allowable if rewritten in independent form. Confirmation is respectfully requested.

Claims 35-37, 41, 43, 61 and 67

Independent claim 35 recites, among other things, a light source that includes first and second multi-spatial mode semiconductor diode lasers, a first reflector in optical communication with the first diode laser and a second reflector in optical communication with the second diode laser, in which the output beams of the first laser and second laser "have different polarizations." The first reflector is aligned with an output beam of the first laser such that a portion of the output beam of the first laser is reflected back into the first laser "by the first reflector." The second reflector is aligned with an output beam of the second laser such that a portion of the output beam of the second laser is reflected back into the second laser "by the second reflector."

The Volodin et al. reference discloses an array 284 of emitters in which light emitted by each of the emitters in the array 284 goes through a wavelength multiplexer 282. The multiplexer 282 is constructed of a monolithic glass chip with wavelength-specific VBG nodes 288 recorded in its bulk, in which the output of the multiplexer 282 is partially reflected by a retro-reflecting device 280 (*see* ¶ [0102]; FIGS. 18A-18B). In rejecting the pending claims, the Office alleges that the VBG nodes 288 correspond to the claimed "first reflector" and "second reflector" (*see* Office action at p. 7). Applicant respectfully disagrees.

There is no disclosure in the Volodin et al. reference that the VBG nodes 288 reflect portions of output beams back into the respective lasers from which the output beams are produced. At most, FIG. 18B of the Volodin et al. reference shows that the VBG nodes 288 merely deflect light towards the retro-reflecting device 280, not the emitter array 284 from which the emitted light is produced. Accordingly, the Volodin et al. reference fails to disclose a "first reflector" to reflect a portion of an output beam back into a first diode laser and a "second reflector" to reflect a portion of an output beam back into a second diode laser, as recited in pending claim 35.

The Office also alleges that because the emitter array 284 outputs light at different wavelengths, the emitter array 284 also outputs light having different polarizations (*see* Office action at p. 8). This, too, is incorrect. It is well known by those of ordinary skill in the art that light produced by a first laser at a first wavelength does not necessarily have a different polarization from light produced by a second laser at different wavelength.

Accordingly, the Volodin et al. reference fails to disclose the subject matter of pending claim 35. Nor would one of ordinary skill in the art have had any reason to modify the device of the Volodin et al. reference to obtain the claimed subject matter, based solely on the known prior art. For at least the foregoing reasons, Applicants submit that independent claim 35 is neither anticipated by nor obvious in view of the Volodin et al. reference and ask, therefore, that the 102 rejection of claim 35 be withdrawn.

Claims 36-37, 41, 43 and 61 depend from claim 35 and should be allowed for at least the same reasons as claim 35.

Claim 67 recites, among other things, a light source that includes first and second multi-spatial mode semiconductor diode lasers, a first reflector in optical communication with the first diode laser, a second reflector in optical communication with the second diode laser, and a first beam combiner arranged to combine the output beams of the first and second laser, in which the beam combiner is a third reflector having a three-dimensional pattern of refractive index variations within the third reflector.

As explained above in regard to claim 35, the Volodin et al. reference fails to disclose a "first reflector" to reflect a portion of an output beam back into a first diode laser and a "second reflector" to reflect a portion of an output beam back into a second diode laser. However, even if the VBG nodes 288 of the Volodin et al. reference did correspond to the claimed "first reflector" and "second reflector," which Applicant does not concede, the Volodin et al. reference fails to disclose a beam combiner, which is a third "separate reflector" having a three-dimensional pattern of refractive index variations. Although the Volodin et al. reference discloses combining the output of emitter array 284 with multiplexer 282, the Volodin et al. reference fails to disclose that the multiplexer 282 is a "separate reflector" from the VBG nodes 288, as recited in claim 67 of the present application. Instead, the Volodin et al. reference discloses that the multiplexer 282 is "constructed of a monolithic glass chip <u>with wavelength-specific VBG nodes 288</u>" such that the VBG nodes 288 are <u>part of</u> the multiplexer (*see* ¶ [0102], emphasis added). Clearly, therefore, the multiplexer 282 cannot correspond to a "separate reflector," as recited in claim 67 of the present application.

Accordingly, the Volodin et al. reference fails to disclose the subject matter of pending claim 67. Nor would one of ordinary skill in the art have had any reason to modify the device of the Volodin et al. reference to obtain the claimed subject matter, based solely on the known prior art. For at least the foregoing reasons, Applicants submit that claim 67 is allowable over the Volodin et al. reference and ask, therefore, that the prior art rejection of claim 67 be withdrawn.

Conclusion

In view of the above remarks, claims 1, 4, 7, 9, 13-17, 20-21, 23-26, 28, 35-37, 41, 43-47, 49-52, 54, 58-61, 64-67 and 69 should be in condition for allowance, and a formal notice of allowance is respectfully requested.

It is believed that all of the pending claims have been addressed. However, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

No fee is believed due. However, please apply any charges or credits to deposit account 06-1050.

Respectfully submitted,

Date: 1/22/10

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